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READING BLUE LIMESTONE.

By ALVA J. SMITH, Emporia.

Read before the Academy, at Topeka, December 30, 1904.

THIS name is proposed for a hard blue limestone which extends across Greenwood, Lyon and Osage counties, and probably much further.

The outcropping margin of the stone is broken by the frost into irregular fragments, which weather into more or less rounded forms on the upper surface. A freshly broken surface of the stone is blue, the color gradually changing by the action of the weather to a brown, and finally to a buff.

The results of an analysis are as follows:

Hardness, 4; specific gravity 2.70.

Insoluble portion	9.50	per cent.
Aluminates and ferric carbonate ($FeCO_3$)	10.00	"
Calcium carbonate ($CaCO_3$)	78.50	"
Magnesium carbonate ($MgCO_3$)	2.00	"
Total	100.00	per cent.

Well-water taken from the shale below the blue stone is saline and yields on analysis from 25 to 300 parts per million of chlorine as sodium chloride.

At Humphrey's ford, six miles southeast of Emporia, the following section is found (beginning at the bottom):

	1.	Barclay limestone, about	12
Humphrey shales,	2.	Yellow and blue shale	9
	3.	Limestone	1
	4.	Shale	15
	5.	Limestone, friable (*Streptorhynchus crenistria*)	6
	6.	Blue and yellow shale	13½
	7.	Reading blue limestone	3

The following fossils have been taken from the blue stone near Emporia:

Crinoid columns.
Fusulina cylindrica.
Chonetes granulifera.
Productus cora.
Rhomboporia lepidodendroides.
Setopora biserialis.
Enteletes hemiplacata.
Seminula argentea.

DEFINITION AND SYNONYMY.

The first reference made to the Emporia limestone is found in volume 1 of the University Geological Survey of Kansas, page 80, in Kirk's Neosho river section, where it is mentioned as being first seen in Chicago mound, near Wyckoff. This system he says disappears under the Neosho river near the Emporia water-works.

The same author, on page 82, refers to a stone quarried in section 28, township 19, range 11, as the Emporia limestone. Careful observation has proven that the formations at the locations mentioned are three different strata, the first being separated from the later by about sixty feet of shale, and the later from the one found at the water-works by ten feet, making in all, including the limestones, a thickness of eighty-six feet included within the formation he calls the Emporia limestone.

In a paper read before this Academy previously, I suggested the name "Emporia blue limestone" for the lower stone mentioned by Kirk, and that the name "Emporia" be retained for the system of five limestones, sixty feet above. The name "Emporia limestone" would thus include the formation quarried in section 28 and the one found at the Emporia water-works.

It was thought at that time that the word "blue" added to "Emporia" in the former instance would be a sufficient distinction to prevent confusion, but on more careful study the blue stone is found to be the more important of the two, being more persistent stratigraphically and much more valuable commercially. As the blue color of the stone under discussion is a very prominent characteristic, it seems desirable to retain that portion of the name. But to avoid any possibility of confusion in the future, I now propose the name "Reading blue limestone" to be applied to the formation.

As this stone lies within the Olpe shales as defined by George I. Adams on page 52 of the United States Geological Survey Bulletin No. 211, it seems necessary to either supply new names for the shales above and below this stone or restrict the extent of the Olpe shales to one portion or the other. I will therefore propose the name "Humphrey shales" for the beds of shales and limestone forty to forty-five feet in thickness between the Burlingame or Barclay limestone and the Reading blue; and that the name "Olpe shales" be applied to the sixty feet of arenaceous and carbonaceous shale overlying the blue stone and extending up to the Emporia system of five stones.

This leaves the upper limit and the thickness of the Olpe shales the same as originally given by Adams, but the lower limit is changed from the Barclay to the Reading blue stone.

OUTCROP.

The outcrop of the blue limestone, as shown in plate XXIII, enters Lyon county from the south in section 32, township 21, range 11, and extends northwesterly along the sides of the hills and bluffs on the west side of Rock creek about one and one-half miles, to a point where it passes under the stream; thence easterly it skirts the hills and bluffs of Moon creek, Tate's branch and Smith creek and numerous small streams and ravines, creating in most places a well-defined escarpment for a distance of about nine miles. In several places it extends south in the high ridges into Greenwood county.

In sections 25 and 26, in township 21, range 12, near the head waters of Smith and Four Mile creeks, is an outlier a mile or more in length by one-half mile in width.

There is a quarry located near the center of section 33, township 21, range 12, and another in the southeast quarter of section 22, same township and range.

From the last-mentioned quarry the outcrop extends nearly north along the west side of Hoosier creek three miles. It then angles to the northwest, skirting the south branches of Eagle creek, to section 31, township 20, range 12. A good quarry is located near the northeast corner of the southeast quarter of said section, in a bluff about fifty feet above the creek.

The stratum passes under the creek one mile farther up. Thence it trends northeasterly five miles, where it crosses the divide between Eagle creek and the Neosho river, in section 16, township 20, range 12. A good quarry is situated on an outlier, near the southeast corner of section 14, from which stone has been taken for a number of bridge abutments.

Another outlier, one-half mile or more in length, is found in sections 3 and 4, and another smaller one at the summit of Chicago mound, in section 34, township 19, range 12, where a quarry has been extensively worked. This is the exposure that Kirk erroneously called the Emporia limestone.[1]

The stratum referred to on the same page as the Wyckoff limestone is equivalent to the one termed "Burlingame" by Haworth and "Barkley" by Adams.[2]

From the south side of section 10, township 20, range 12, the general trend of the outcrop is west, flanking the ravines that flow into Coal creek from the south six miles to a point four miles north of Olpe, where it passes under the creek. Thence it extends northeast five miles to a bluff on the south bank of the Cottonwood river. Thence west, passing through sections 31, township 19, range 12, and section 36, township 19, range 11, where the most extensive quarries on the outcrop are located. Many thousand cords of dimension stone have been taken from these quarries for use in Emporia and vicinity. The ledge passes under the flood-plain of Coal creek three miles south and one-half mile west of Emporia. The footing of the dam at Soden's mill, on the Cottonwood river, rests on this stone. It is also found in wells at Emporia from twenty to forty feet deep, but

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[1] Univ. Geol. Surv., vol. 1, p. 80.

[2] U. S. Geol. Surv. Bulletin No. 211.

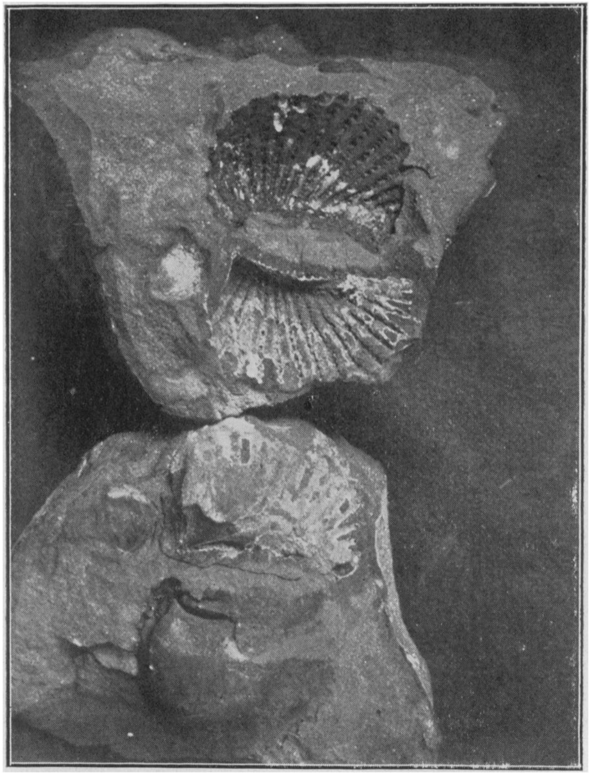

PLATE XVI.—Mentor Fossils—*Trigonia emoryi* Conrad.

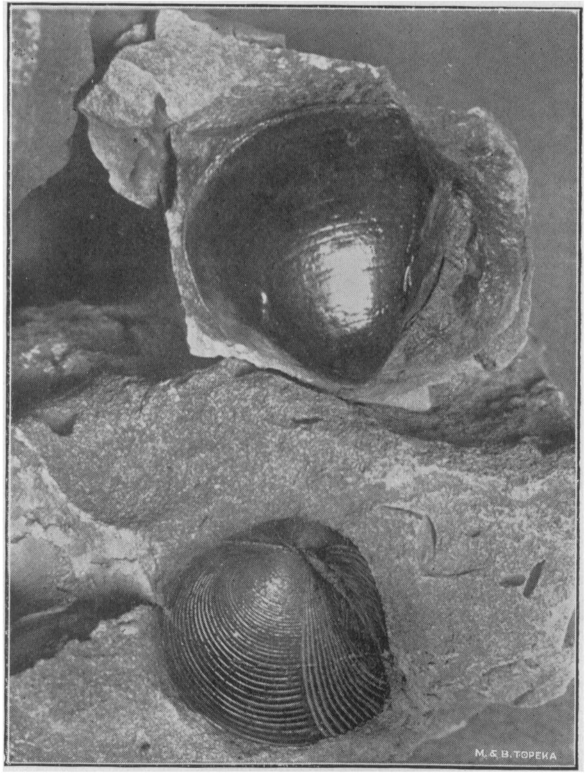

PLATE XVII.—Mentor Fossils—*Protocardia salinaensis* Meek.

no exposures occur till a point one mile east and one-fourth mile north is reached, where the closest quarry to Emporia is situated, in the southeast quarter of section 11. This quarry has been in operation three years, and has produced about 1000 cords of stone. At this quarry the cap rock is seven to eight inches thick and is very rough on the lower side. A seam of buff clay separates this from the main stratum, which is twenty-six inches in thickness. Along the margin of the outcrop a bottom layer five inches thick separates readily from the main ledge, but after working the quarry back twenty feet or more they are found to adhere together in a solid stratum. Parallel seams from six to eight feet apart extend through the stone in a general course north fifty-five degrees east, while irregular transverse seams intersect these at approximately right angles, cutting the surface of the stone into rough parallelograms. A heavy bed of gravel overlays the stone in this quarry and adds materially to the cost of stripping.

The blue limestone is next seen in the Neosho river at Rinker's bridge. From there the stone is covered to a point two miles east, where a quarry is located. From this quarry southeast three miles the country is hilly, and the outcrop may be traced readily around the hills four miles. Thence it extends in a general course north fifteen degrees east along the slopes on the west of Badger creek five and one-half miles, to the south line of section 13, township 18, range 12. From this point there is a long extension of the outcrop southward four miles, with an outlier on the top of Wooster mound, one mile beyond.

The formation leaves Lyon county and enters Osage in section 22, township 18, range 13, and reenters near the northeast corner of the same section, and, bearing northwesterly, flanks the hills at the head of Duck creek, and returns to a point one and one-half miles northwest of Reading, where it has been extensively quarried. Other quarries are located on the west lines of sections 21 and 29, township 17, range 13.

The outcrop is very prominent on both sides of Marais des Cygnes river, and may readily be traced along the west side of the valley of Elm creek to Miller station, where it creates a waterfall in that stream at a ford one-fourth mile west of the depot. It leaves the county at points from three to five miles southeast of Miller, and reenters farther north on Salt creek, about twenty feet above the water, and extends up that stream a mile. I have identified this formation as far .uth as Eureka, in Greenwood county, and north to a point in Osage county two miles east of Harveyville.

The accompanying map, plate XXIII, shows the line of outcrop of the Reading blue limestone, together with other formations in Lyon county.

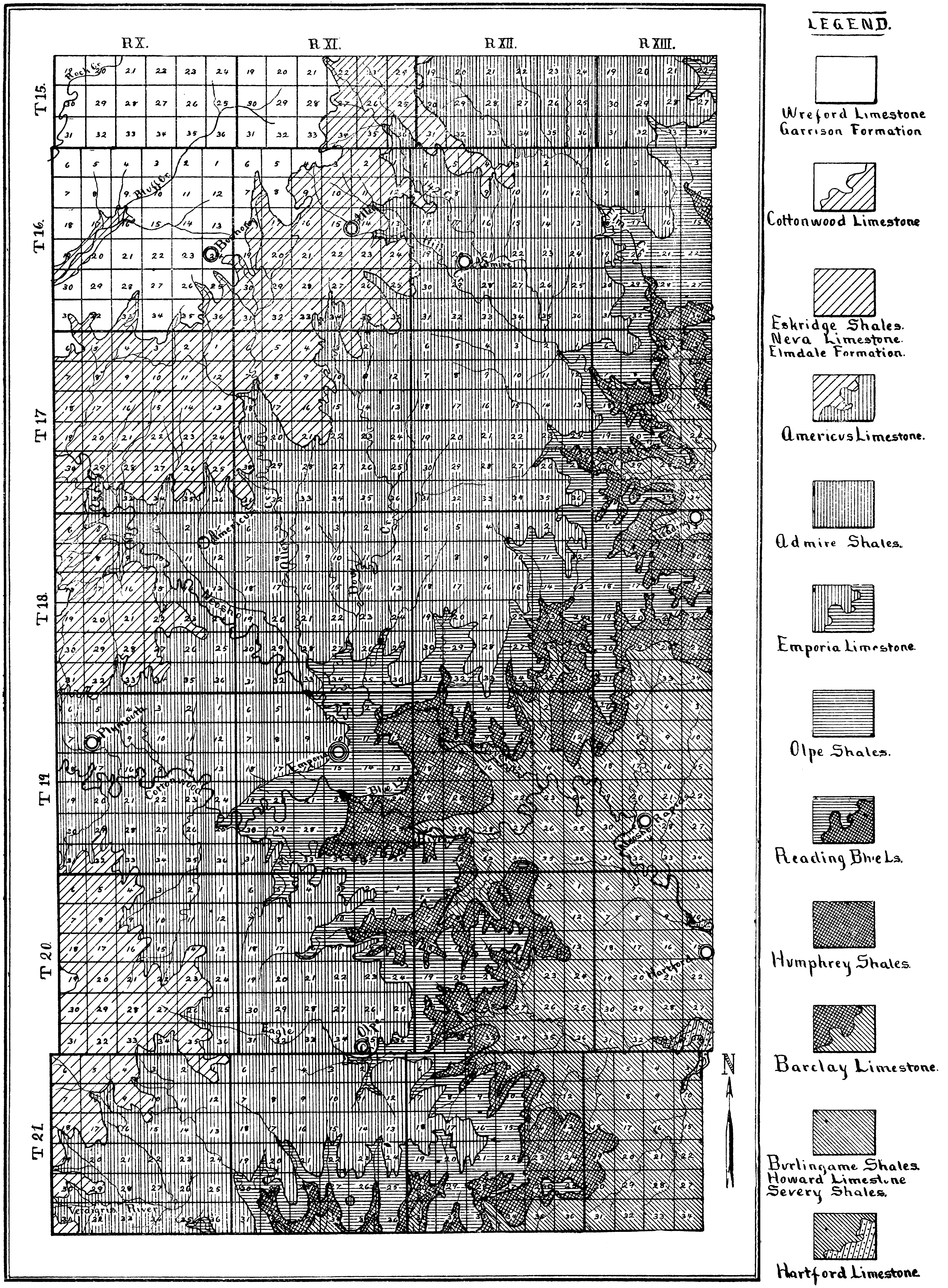

Plate XXIII.—Map showing Area of Reading Blue Limestone. (One-fourth inch equals one mile.)